Floristic reconnaissance of the northern portion of the Gregory National Park, Northern Territory, Australia

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Abstract

A floristic reconnaissance of two areas in the northern portion of the Gregory National Park revealed a range of distinct vegetation types. Numerical classification was used to determine 13 plant communities from an area near Victoria River Crossing and 10 communities from Bullita homestead area. These communites were shown to form significant associations with landform and geology. The latter were found to be closely related, as the topography of the area is strongly controlled by the erosion of Adelaidean sediments, some of which have been capped by Lower Cambrian basalts. The plant communities are best grouped within landform complexes, which include: riverine, plain, undulating terrain, mesa plateau and slope, and plateau/hill rims. These complexes can be subdivided by substrate material and surface soil texture. Vegetation maps at a scale of 1:100 000 were unable to differentiate all the communities due to the complex micro-pattern of some vegetation types.

The complete list of species recorded at the Victoria River and Bullita areas was found to be closely related to the nearby Keep River National Park, but to be poorly related to the Bungle Bungle National Park area in WA. Other areas of sandstone in the northern coastal region of the NT were found to be poorly related to Gregory. It is suggested that these similarities are associated with rainfall and the relative development of sandstone canyons, which act as refugia for mesic plant species. A major management problem of Gregory National Park relates to feral animals and their suspected association with soil erosion and the spread of exotic plants.

Introduction

A basic requirement of nature conservation is an appreciation of the uniqueness and representativeness of nature reserves. Vast areas of the Northern Territory are botanically poorly explored. This lack of basic data hampers conclusions as to the conservation value of reserves in protecting rare or threatened vegetation. One approach to overcome this problem is to produce small scale vegetation maps. This method has the advantage of providing an overview of major vegetation formations, but suffers the disadvantage of treating the flora superficially. Another approach is to analyse biogeographic patterns of Herbarium records (Dunlop & Bowman 1986). The utility of this method however, is dependent upon the thoroughness of past plant collecting.

This paper reports the results of a botanical reconnaissance of Gregory National Park, in which two small areas assessed to represent major land types within the park, were studied in detail. Fieldwork was undertaken to simultaneously ground truth large scale vegetation maps, record data for phytosociological analysis and collect specimens of all vascular plant species for preservation in the Northern Territory Herbarium. Phytosociological analyses were conducted to provide land managers with basic ecological data, and enable comparison with vegetation surveys of other areas in northern Australia, enabling the flora of the park to be placed into a regional context.

The **Appendix** is a Supplementary Publication and is not printed with the paper. Copies are lodged with the Society's Library (c/- Western Australian Museum, Perth WA 6000) and with the National Library of Australia (Manuscript Section, Parkes Place, Barton ACT 2600). Photocopies may be obtained from either institution upon payment of a fee.

Table 1

Climatic data for Victoria River Downs and Timber Creek.

A = mean precipitation (mm); B = mean number of rain days; C = mean daily maximum temperature (°C); D = mean daily minimum temperature (°C).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Victoria River Downs													
A	145	142	106	19	6	2	3	1	4	17	61	112	618
B	11	10	8	2	1	0	0	0	1	2	6	9	50
C	37.0	35.5	34.7	34.7	31.7	29.6	29.0	32.3	35.5	37.7	38.3	38.1	34.5
D	25.0	23.9	23.2	19.8	16.3	12.2	10.8	14.1	18.0	22.0	23.5	24.2	19.8
Timber Creek													
A	197	201	157	25	5	2	1	0.4	4	27	66	128	813
B	12	12	9	2	1	0	0	0	1	3	6	9	55
C&D N/A													

Regional environment

Climate

The climate is monsoonal with five months of summer rains (Table 1). The total annual rainfall (618—813 mm) is between one half to one third of that received at Darwin, and the number of raindays is one half of those recorded for the northern capital. Summer mean maximum daily temperature and winter minimum daily air temperature are more extreme than the north coast of the N T.

Geology

Gregory National Park is situated in the Victoria River Basin (Sweet 1977). During the early Adelaidean, cycles of marine deposition and subsequent uplift and erosion produced sequences of sandstone, siltstone and carbonate rocks (Sweet 1972). Frequent faulting fractured these sediments. Lower Cambrian basalt was extruded across parts of the landscape, with deep lateritization occuring during the Tertiary (Sweet 1972). Uplift and erosion since the late Tertiary have exposed older rocks and produced a landscape of wide plains with resistant sediments forming plateaux and mesas, some with a remnant lateritized cap.

Soils

Soils of the park are generally related to lithology and topographic position. Much of the area consists of steep tablelands and hills with shallow immature skeletal soils (Stewart 1970). Deep soils are confined to gentle lower slopes, where red and yellow earths are common with poorly drained lower slopes possessing cracking clays. Alluvial soils, invariably cracking clays, have developed on river flats.

Methods

Landsat imagery at a scale of 1:250 000 was visually interpreted to produce a map of gross land types (Fig. 1). From this interpretation, areas of approximately 25 by 25 km, near the Victoria River Crossing and the Bullita homestead, which were assessed as being representative of enviroments within the park and important for public access, were selected for intensive study. Photopatterns of the two areas were delineated on 1:80 000 scale, 1968, black and white aerial photographs and 1:100 000 maps compiled.

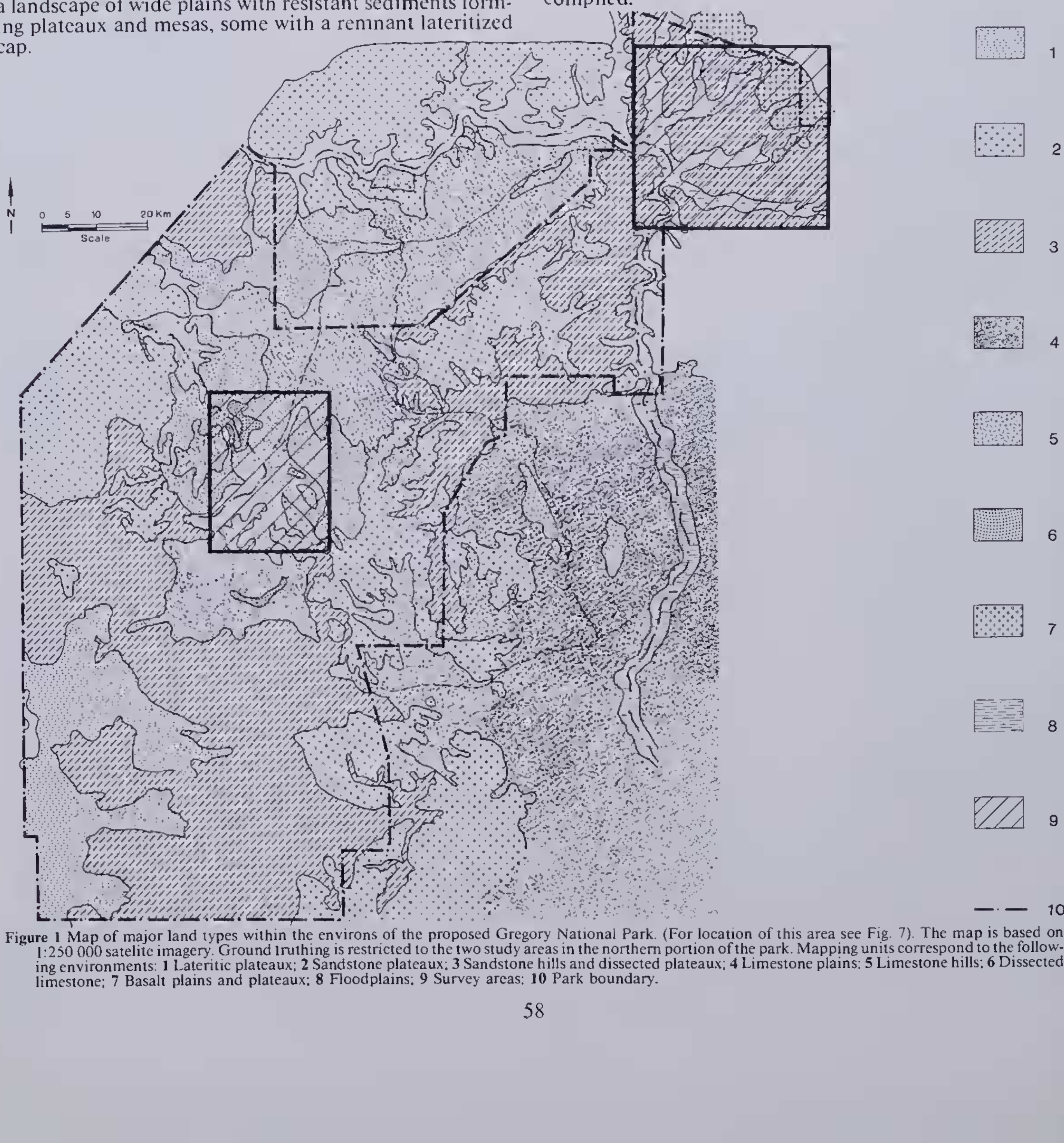

Figure 1 Map of major land types within the environs of the proposed Gregory National Park. (For location of this area see Fig. 7). The map is based on 1:250 000 satelite imagery. Ground truthing is restricted to the two study areas in the northern portion of the park. Mapping units correspond to the following environments: **1** Lateritic plateaux; **2** Sandstone plateaux; **3** Sandstone hills and dissected plateaux; **4** Limestone plains; **5** Limestone hills; **6** Dissected limestone; **7** Basalt plains and plateaux; **8** Floodplains; **9** Survey areas; **10** Park boundary.

A total of 327, 10 by 10 m quadrats were placed (181 at Victoria River and 146 at Bullita) within identified photopatterns, using a combination of systematic sampling of tracks, field traverse and helicopter landings during late February and early March 1986. The presence of all vascular plant species was noted in each quadrat. The structure of surrounding vegetation was classified according to the scheme of Walker & Hopkins (1986) and subsequently converted to the scheme of Specht (1981). The topographic position off quadrats was classified as either: mesa top, mesa/hill rim, mesa sideslope, mesa gully, hilltop, hill sideslope, plain, permanent watercourse, ephemeral watercourse or drainage basin. Rock outcrop was noted as either sandstone, limestone, sandstone/limestone mix, basalt, laterite or covered with alluvial deposits. The percent cover of rock, gravel and bare ground was noted. Surface soil texture was classified as either sand, loam or silt/clay.

Data analysis

Floristic and environmental data are stored on the ecological data base system ECOPAK (Minchin 1986). Victoria River and Bullita data sets were classified separately. Before analysis, species that occurred in less than three quadrats were deleted from the matrix. The presence/absence floristic data for each site were subjected to an agglomerative classification using the UPGMA sorting strategy after calculating a Bray-Curtis similarity matrix using the Numerical Taxonomy Package NTP (Belbin *et al.* 1985). The classification was imposed on the relatively continuous variation across the communities. As there are no defined stopping rules in classification, the level of truncation, which was not consistent across the dendrograms, was determined subjectively after careful inspection with lists of species memberships. The association between the non-parametric environmental variables and the floristic groups was tested for departure from randomness by Chi-square analysis.

The centroids of the resulting 23 floristic groups were ordinated by Detrended Correspondence Analysis (Hill & Gauch 1980). Because of limitations in computer space, only those species that ocurred in more than 5 groups (245) were used in the ordination.

Community definitions

Thirteen floristic groups were recognized at Victoria River (Fig. 2) and 10 floristic groups were recognized at Bullita (Fig. 3). Structural classification (following Specht 1981) and dominant species for the upper, mid and lower strata for each group, are shown in Tables 2 & 3.

A total of 517 species was encountered in the survey. Their percent frequency occurrence by classification group is indicated in the Appendix.

Table 2

Structural classification (Specht 1981) and dominant species for upper, mid and lower strata for floristic groups at Victoria River

Group No	Upper stratum	Middle stratum	Lower stratum
1	Low open-woodland of *Eucalyptus dichromophloia, E. ferruginea, E. miniata.*	Shrubland of *Acacia laccata* and *Grevillea* spp.	Grassland of *Plectrachne pungens* and *Eriachne ciliata.*
2	Low woodland of *E. dichromophloia* and *Erythrophleum chlorostachys.*	Shrubland of *Petalostigma quadriloculare, Cochlospermum fraseri* and *Calytrix exstipulata.*	Grassland of *Plectrachne pungens* and *Eriachne ciliata.*
3	Woodland of *E. miniata* with subdominant *Terminalia latipes* and *Owenia vernicosa.*	Shrubland of *Buchanania obovata, Templetonia hookeri* and *Acacia* spp.	Open-grassland of *Plectrachne pungens* and *Fimbristylis pauciflora.*
4	Forest of *Livistona* sp. nova *Pouteria sericea, Ficus* spp. and *Vitex glabrata.*		Sparse ferns and *Cyperaceae spp.*
5	Woodland of *E. tectifica* and *Lysiphyllum cunninghamii.*	Shrubland of *Ampelocissus acetosa* and *Hakea arborescens.*	Grassland of *Heteropogon contortus Sorghum plumosum* and *Sehima nervosum.*
6	Low open-woodland of *E. tectifica* with co-dominant *Erythrophleum chlorostachys.*		Grassland of *Sehima nervosum. Themeda avenacea* and *Eriachne ciliata.*
7	Open-woodland of *E. tectifica* and *E. terminalis*	Open-shrubland of *Atalaya hemiglauca* and *Grewia retusifolia.*	Grassland of *Sehima nervosum Dichanthium fecundum* and *Chrysopogon fallax.*
8	Low woodland of *Erythrophleum chlorostachys, E. tectifica* and *E. confertiflora.*	Open-shrubland of *Atalaya hemiglauca* and *Grewia retusifolia.*	Open-grass/herbland of *Plectrachne pungens, Tacca leontopetaloides* and Fabaceae spp.
9	Open-forest of *Ziziphus quadrilocularis, Strychnos lucida* and *Celtis philippinensis* with emergent *E. confertiflora.*		Sparse *Commelina ensifolia* and *Passiflora foetida.*
10	Low woodland of *Melaleuca argentea, Lophostemon grandiflorus, Terminalia platyptera* and *Pandanus aquaticus.*		
11	Woodland of *E. camaldulensis, Nauclea orientalis* and *Ficus coronulata.*		Open-grassland of *Echinochloa colona* and *Cynodon dactylon.*
12	Closed-forest of *Syzygium angophoroides, Livistona* sp nova and *Ficus* spp.		Open-sedge/herbland.
13	Low closed-forest of *Melaleuca symphyocarpa* with emergent *Melaleuca leucadendra.*		Sparse cover of Cyperaceae spp.

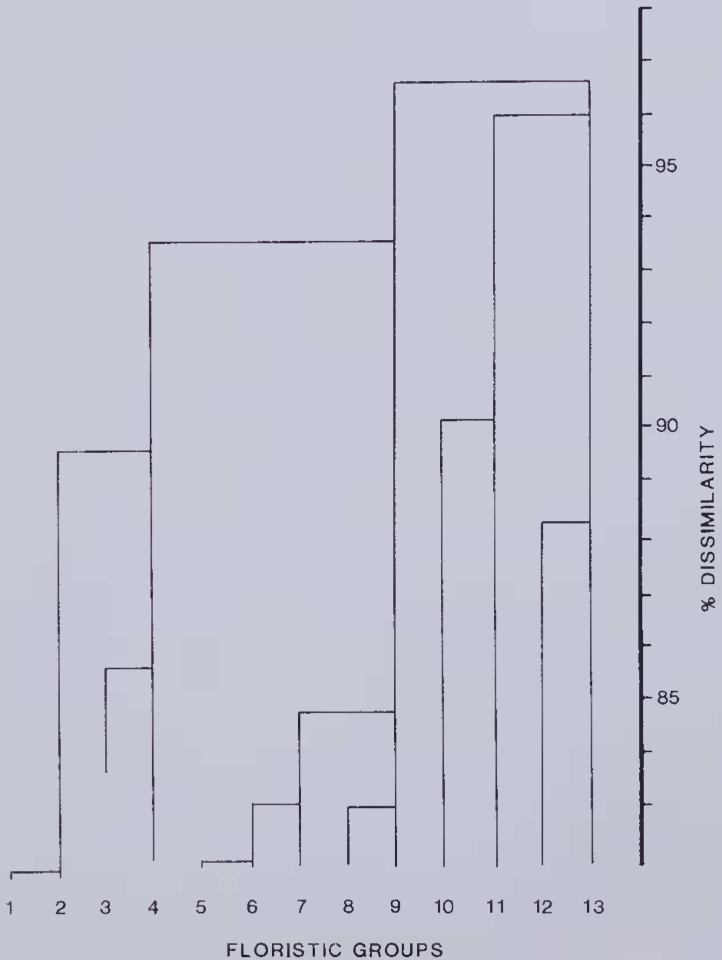

Figure 2 Dendrogram of floristic similarities of quadrats placed at Victoria River. The classification was truncated at the thirteen group level.

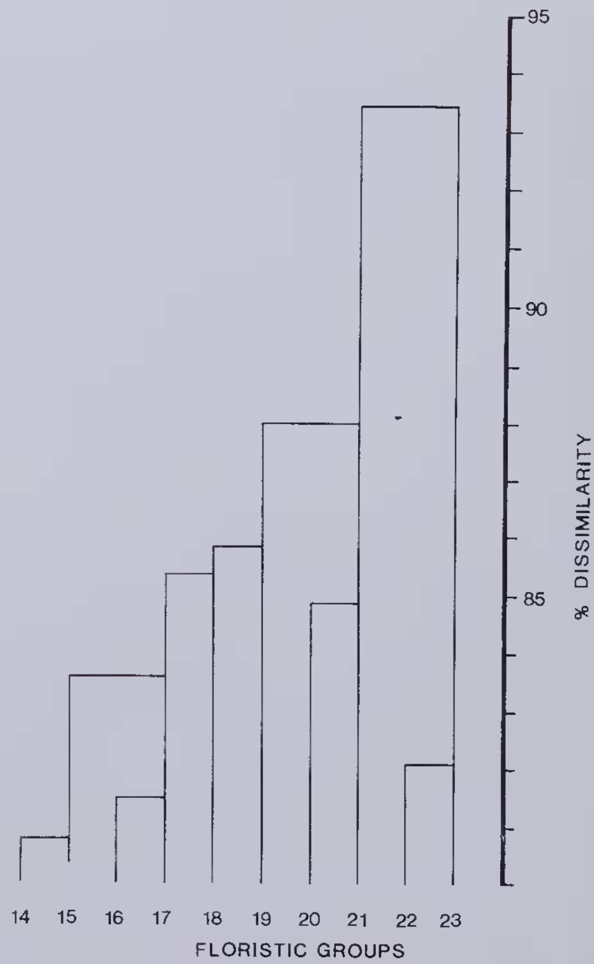

Figure 3 Dendrogram of the floristic similarities of the quadrats placed at Bullita. The classification was truncated at the ten group level.

Table 3

Structural classification (Specht 1981) and dominant species for upper, mid and lower strata of floristic groups at Bullita.

Group No	Upper stratum	Middle stratum	Lower stratum
14	Woodland of *Lysiphyllum cunninghamii E. tectifica, E. terminalis, E. pruinosa* and *Adansonia gregorii.*	Shrubland of *Ampelocissus acetosa* and *Hakea arborescens.*	Grassland of *Heteropogon contortus* and *Sorghum plumosum.*
15	Open-woodland of *Lysiphyllum cunninghamii, E. tectifica, Terminalia canescens.*	Open-shrubland of *Carissa lanceolata Ampelocissus acetosa* and *Flueggea virosa.*	Grassland of *Sorghym plumosum Themeda avenacea* and *Heteropogon contortus.*
16	Low open-woodland of *E. brevifolia, E. dichromophloia* and *Terminalia canescens*	Open-shrubland of *Ampelocissus acetosa, Flueggea virosa* and *Cochlospermum fraseri.*	Grassland of *Plectrachne pungens Themeda avenacea* and *Sehima nervosum.*
17	Low open-woodland of *E. dichromophloia* and *E. ferruginea.*	Open-shrubland of *Grevillea pyramidalis* and *Ampelocissus acetosa.*	Grassland of *Sorghum plumosum* and *Plectrachne pungens.*
18	Tall Shrubland of *Acacia leptocarpus* and *Acacia lysiphloia* with emergent *E. tectifica*		Grassland of *Heteropogon contortus Aristida browniana* and *Sehima nervosum.*
19	Open-woodland of *Adansonia gregorii, E. tectifica* and *E. pruinosa.*	Shrubland of *Dodonaea physocarpa* and *Ampelocissus acetosa*	Grassland of *Plectrachne pungens* and *Aristida browniana.*
20	Open-forest of *Terminalia platyphylla Lophostemon grandiflorus, Melaleuca leucadendra* and *Ficus coronulata.*	Shrubland of *Flueggea virosa* and *Acacia holosericea.*	Grassland of *Heteropogon contortus* and *Echinochloa colona.*
21	Low closed-forest of *Celtis philippinensis, Ficus* spp. and *Strychnos lucida.*		Open herb/vineland of *Passiflora foetida, Jasminum didymum*
22	Open-shrubland of *Acacia laccata* and *Cochlospermum fraseri.*		Grassland of *Plectrachne pungens*
23	Low open-woodland of *E. ferruginea* and *E. brevifolia.*	Open-shrubland of *Grevillea angulata, Grevillea refracta* and *Acacia spp.*	Open-grassland of *Plectrachne pungens* and *Eriachne* spp.

Relationship of mapping units and floristic communities

Tables 4 & 5 show there is a significant relationship between floristic communities and mapping units. However this relationship is not perfect; one floristic group may be significantly associated with more than one mapping unit, as some communities are not possible to differentiate on the maps due to scale and their diffuse boundaries. Two mapping units (10 & 11) are significantly associated with the same florisitic community (Group 14). However mapping unit 11 contains riverine communities (Groups 19 & 20) in contrast to unit 10.

Table 4

Frequency of quadrat occurrence by floristic group and mapping unit at Victoria River. Asterisks denote values showing significant associations following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

	Floristic group												
Mapping unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1	1	0	0	0	18***	3*	4*	0	3	2	14***	0	0
2	18**	0	13*	5	8	0	1	2	1	1	0	1	0
3	2	10***	11*	6**	1	0	0	1	0	0	0	2	1
4	2	9***	4	0	0	0	0	2	0	0	0	0	0
5	1	0	0	0	3	2	1	5	6***	0	0	0	0
6	9***	0	0	0	1	0	0	0	0	0	0	0	0
7	0	0	0	0	2	4***	1	0	0	0	0	0	0
Total	33	19	28	11	33	9	7	10	10	3	14	3	1

Table 5

Frequency of quadrat occurrence by floristic group and mapping unit at Bullita. Asterisks denote values showing significant associations following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

	Floristic Group									
Mapping Unit	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
8	0	0	0	0	0	0	1	1	0	0
9	5	8	3	0	1	0	0	0	1	0
10	19*	5	0	0	2	0	0	0	1	0
11	41*	2	1	0	1	5*	9*	3	0	0
12	0	0	0	0	0	0	0	0	0	0
13	1	11***	8***	0	1	0	0	1	0	0
14	0	1	5*	2***	0	0	0	0	1	6*
Total	66	27	17	2	5	6	10	6	3	6

Environmental relationships

Tables 6,7,8 & 9 show that the vegetation types defined by the numerical classification are strongly related to topographic position and substrate material. Table 10 shows that substrate material is significantly associated with landform. Therefore the the communities can be primarily grouped by landform with secondary differentiation by substrate material.

Table 6

Frequency of quadrat occurrence by floristic group and topographic position at Victoria River. Asterisks denote values showing significant associations following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

	Floristic group												
Topographic position	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Mesa top	10*	15**	2	0	0	0	0	0	0	0	0	0	0
Mesa rim	1	1	11***	2	1	0	0	2	5	0	0	0	0
Mesa side-slope	11**	0	4	0	5	0	1	4*	0	0	0	0	0
Mesa gully	0	0	8***	7*	0	0	0	0	1	0	0	2**	0
Hill top	4	0	0	0	3	1	0	1	0	0	0	0	0
Hill side-slope	2	1	0	0	0	0	0	1	0	0	0	0	0
Plain	2	0	0	0	9*	8***	4**	0	0	0	1	0	0
Permanent water course	0	1	1	2	10	0	1	2	0	2	13***	1	1
Epemeral water course	2	1	0	0	5	0	0	0	4***	1	0	0	0
Drainage basin	1	0	0	0	0	0	1	0	0	0	0	0	0
Missing			2										
Total	33	19	26	11	33	9	7	10	10	3	14	3	1

Table 7

Frequency of quadrat occurrence by floristic group and substrate type at Victoria River. Asterisks denote values showing significant associations following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

Substrate Type	Floristic group												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Basalt	2	0	0	0	1	1	0	1	4**	0	0	0	0
Laterite	7***	1	0	0	1	0	0	1	2	0	0	0	0
Sandstone	22	17	28***	11	9	5	3	8	0	1	0	2	0
Alluvium	0	0	0	0	22***	3	4	0	4	2	14***	0	1
Limestone	0	1	0	0	0	0	0	0	0	0	0	0	0
Missing	2											1	
Total	31	19	28	11	33	9	7	10	10	3	14	2	1

Table 8

Frequency of quadrat occurrence by floristic group and topographic position at Bullita. Asterisks denote values significantly associated, following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

Topographic position	Floristic group									
	14	15	16	17	18	19	20	21	22	23
Mesa top	0	0	2	2**	0	0	0	0	1	6**
Mesa rim	0	0	4*	0	0	0	0	2**	0	0
Mesa side-slope	3	21***	8	0	1	0	0	1	2	0
Mesa gully	1	2	2	0	1	0	1	0	0	0
Hill top	8	2	0	0	1	0	1	1	0	0
Hill side-slope	3	0	0	0	1	0	0	0	0	0
Plain	33***	2	1	0	0	5**	0	0	0	0
Permanent water course	5	0	0	0	0	0	6***	1	0	0
Ephemeral water course	9	0	0	0	0	0	2	0	0	0
Drainage basin	4	0	0	0	1	0	0	0	0	0
Missing						1		1		
Total	66	27	17	2	5	5	10	5	3	6

Table 9

Frequency of quadrat occurrence by floristic group and substrate at Bullita. Asterisks denote values showing significantly associations, following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

Substrate Type	Floristic group									
	14	15	16	17	18	19	20	21	22	23
Limestone	34	13	1	0	4	0	3	4	2	0
Sandstone	14	11	12	2	1	0	0	1	1	6***
Lime/Sandstone	1	3	3**	0	0	0	0	0	0	0
Alluvium	17	0	1	0	0	5***	7**	0	0	0
Missing						1		1		
Total	66	27	17	2	5	5	10	5	3	6

Table 10

Frequency of quadrat occurence by topographic position and geology for Victoria River and Bullita. Asterisks denote values significantly associated following one sample Chi-square analysis (* P<0.05, ** P<0.01, ***P<0.001).

Topographic position	Substrate Type					
	Laterite	Sandstone	Lime/Sandstone	Limestone	Basalt	Alluvium
Mesa top	6***	30**	0	1	1	0
Mesa rim	3	20	0	3	3*	0
Mesa side-slope	2	41	4*	12	2	0
Mesa gully	0	17	3***	3	1	1
Hill top	1	5	0	2	0	0
Hill side-slope	0	7	0	12***	2	1
Plain	0	18	0	14	0	33***
Permanent-watercourse	0	8	0	5	0	33***
Ephemeral-watercourse	0	6	0	8	0	10
Drainage Basin	0	3	0	2	0	2
Total	12	155	7	62	9	80

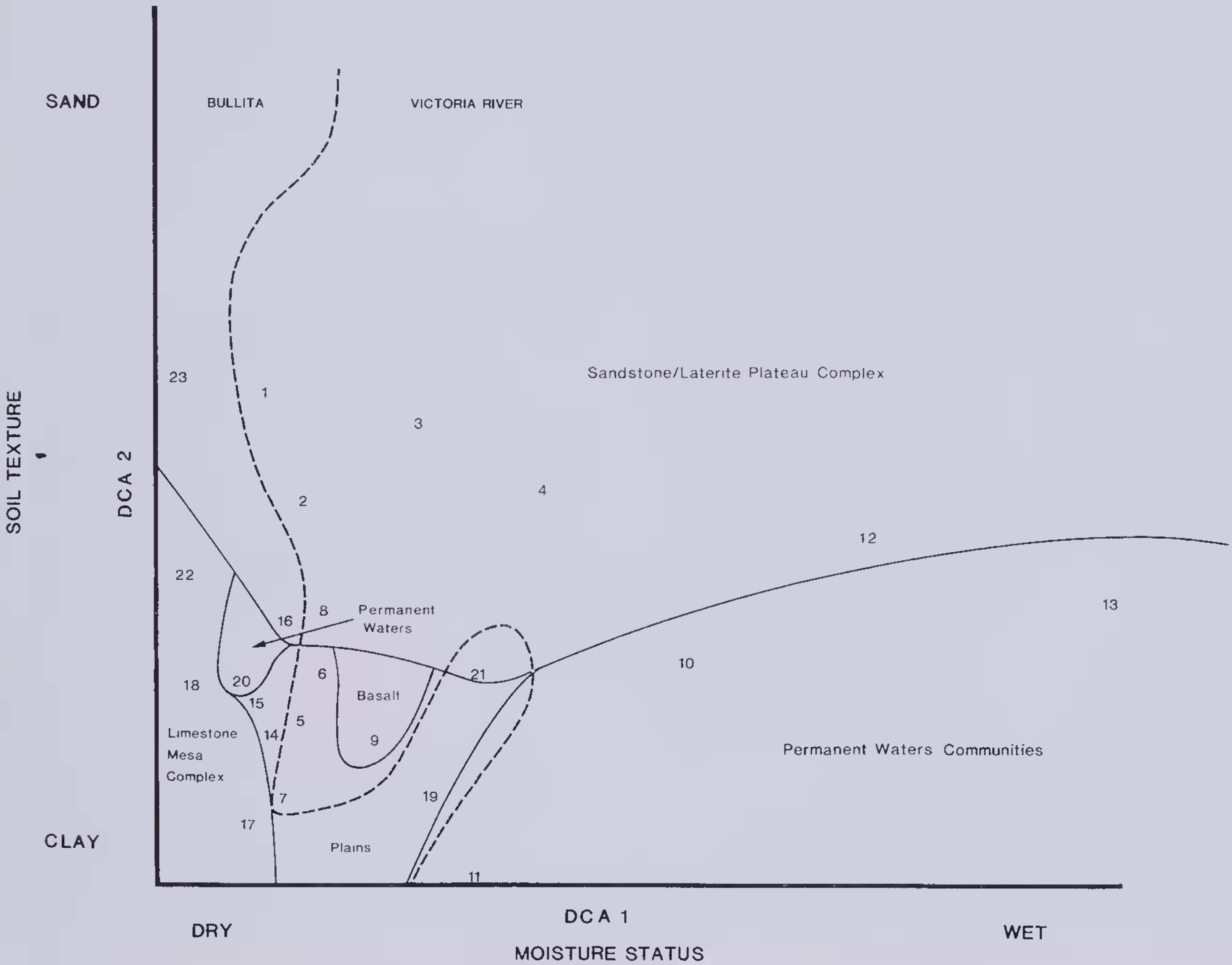

Figure 4 Plot of the centroids of the floristic classifications of the Victoria River and Bullita floristic groups derived from the classification in the first two axes of a Detrended Correspondence Analysis ordination (DCA). The dashed line indicates the division between Victoria River and Bullita. Envelopes are placed around centroids with like geologics and landforms.

Mesa plateau communities

All plateau and mesa tops support eucalypt low open-woodlands. Floristic groups 1 and 2 dominate the sandstone and laterite plateaux at Victoria River. At Bullita Group 17 and 23 occur on sandstone substrate plateaux.

Mesa plateau and mesa/hill rim communities

The sandstone plateau rims at Victoria River are dominated by *Eucalyptus miniata* woodlands of floristic Group 3. At Bullita limestone and/or sandstone rims support *E. brevifolia* low woodlands (Group 16) while limestone rims carry low *Celtis philippinensis* closed-forest (Group 21).

Mesa sideslopes

Mesa sideslopes at Victoria River support *E. dichromophloia* woodlands (Group 1). These sandstone slopes support low woodlands dominated by *Erythrophleum chlorostachys* (Group 8). At Bullita sandstone slopes support *Lysiphyllum cunninghamii* dominated woodlands (Group 15) while limestone slopes are either covered in this community or open-shrublands dominated by *Acacia laccata* (Group 22).

Mesa gullies

Three communities occur in sandstone gullies at Victoria River. *Eucalyptus miniata* woodlands (Group 3), which also occur on plateau rims, occur in the driest gullies. In moist gullies *Livistonia* 'Victoria River' forests occur (Group 4). In deep protected gullies closed-forests dominated by *Syzygium angophoroides* shade fern understories (Group 12). The gullies on mesas at Bullita are shallow and do not support characteristic vegetation types.

Hills

Hill communities are only significant at Bullita, associated with rounded limestone outcrops. They support tall shrubland dominated by *Acacia leptocarpa* (Group 18).

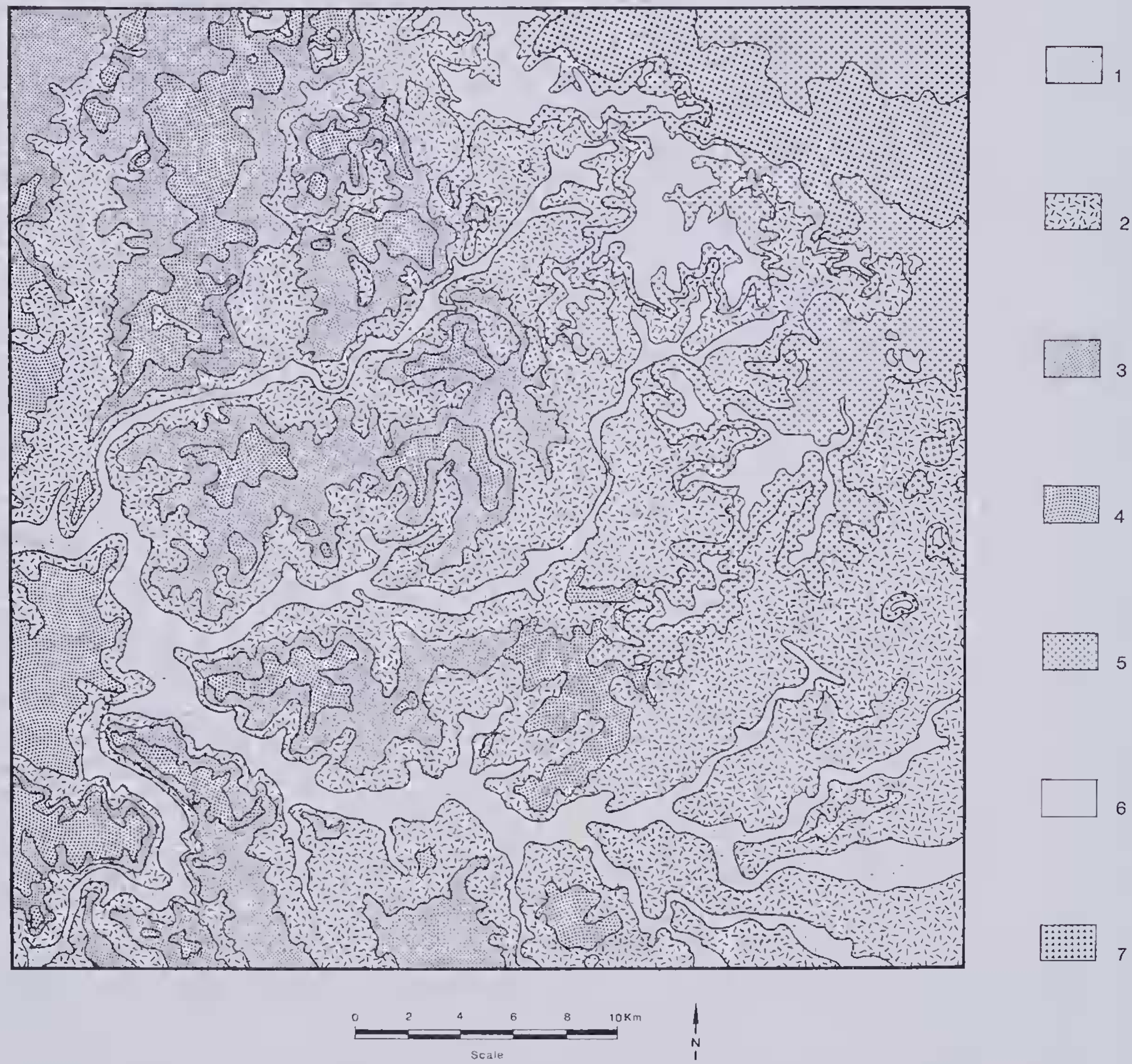

Figure 5 Map of repeatable photo-patterns at Victoria River. Mapping units correspond to the following environments: 1 Plains and Rivers; 2 Sandstone plateau sideslopes; 3 Sandstone plateau rims and upper slopes; 4 Sandstone plateau tops; 5 Basalt sideslopes; 6 Lateritised basalt plateaux; 7 Basalt plains.

Plains

Alluvial plains with residual rock outcrops support three interrelated types of *E. tectifica* woodlands (Groups 5, 6 & 7). At Bullita the alluvial deposits on the plains support *E. tectifica* open-woodlands with emergent *Adansonia gregorii* trees (Group 19). *Lysiphyllum cunninghamii* woodlands are found on sites with either limestone or sandstone rock, or alluvial deposits (Group 14).

Permanent water communities

These communities are more diverse and abundant at Victoria River than Bullita. In the Victoria River area, *E. camaldulensis* woodlands are found on levees with deep alluvial soils (Group 11). Low *Melaleuca argentea* woodlands (Group 10) occur on river banks. In poorly drained depressions low *Melaleuca symphyocarpa* closed-forest occur (Group 13). At Bullita *Lophostemon grandiflora* open-forest characterizes the riverine communities (Group 20).

Ephemeral water communities

The dry creeks on basalt plateaux support mixed species open-'monsoon' forest dominated by species such as *Ziziphus quadrilocularus* and *Strychnos lucida* (Group 9).

Species diversity of the landform-vegetation complexes

The ephemeral water community is the most species rich community (26.9 species per 100 m^2) while the permanent water communities have the greatest range of species richness (7—19.9 species per 100 m^2). The plains communities are generally richer than the elevated communities with the exception of the low *Erythrophleum* woodland (Group 8) which is the second most diverse community (Appendix).

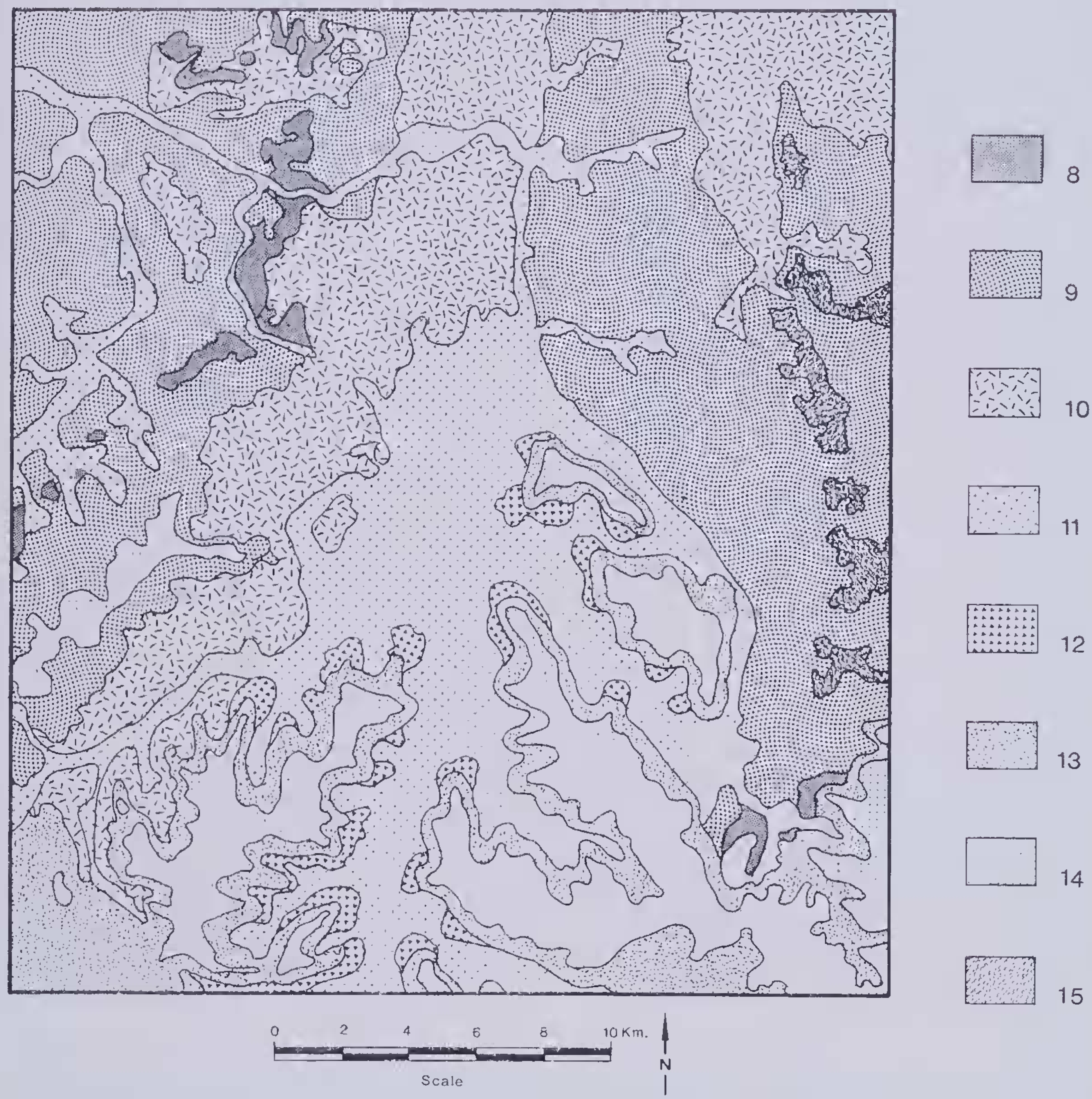

Figure 6 Map of repeatable photo-patterns at Bullita. Mapping units correspond to the following environments: **8** Limestone plateaux; **9** Undulating limestone country; **10** Plains and rivers; **11** Plains; **12** Eroded devegetated areas; **13** Sandstone/Limestone mesa sideslopes; **14** Sandstone/Limestone mesa tops; Not ground truthed.

Comparison between Victoria River and Bullita areas

Ordination of the centroids of the 23 communities shows that the main differences between Bullita and Victoria River is moisture status and the occurence of basalt and limestone (Figures 4, 5 & 6). The permanent water community at Bullita is floristically distinct from the four at Victoria River, the former sharing more species with the limestone hill complex. The limestone mesa complex is distinct from the sandstone and laterite plateau complex possibly due to the formers clay-rich basic soils which gives it more affinity with the plains communities. The plain communities are similar at both Bullita and Victoria River even though the geologies of the two areas are different. The sandstone/laterite plateau complex is shared by both Bullita and Victoria River. The driest communities in this complex occur at Bullita while at Victoria River these communities span the moisture gradient (as defined by DCA 1) from plateaux with skeletal soils through to deep sheltered canyons. Variation in the plateaux communities at Bullita is associated with changes in surface soil texture and substrate material (DCA 2).

Comparison of Gregory with other areas in northern Australia

The vegetation communities described at Victoria River and Bullita approximate the general descriptions provided for the Ord-Victoria area by Perry (1970), the Bungle Bungle Ranges by Forbes & Kenneally (1986) and Keep River National Park by Henshall & Mitchell (1979) and Sivertsen & Van-Cuylenburg (1986). More detailed floristic comparisons with the complete Gregory list (Appendix) were made with the above authors' species lists, the list for Uluru National Park (or Ayers Rock, Hooper *et al.* 1973), Katherine Gorge N P (Sivertsen & Day 1986), Alligator Rivers Region (or Kakadu, Taylor & Dunlop 1985) and Litchfield Park (or Tabletop Range, Kirkpatrick *et al* 1988 and Lynch & Manning 1988) (Fig. 7 and Table 11). Because the above surveys were conducted in different seasons and at different levels of intensity, a conservative measure of floristic similarity was used: number of species in common / the lowest number of species in either species list. This analysis shows that Keep River has the highest similarity with Gregory (53%) while Ayers Rock has the least number of species in common (10%). Katherine Gorge, the Bungle Bungles, Alligator Rivers and Litchfield have lower similarities (42, 37, 33 & 34% respectively).

The similarities of the areas generally reflect north-south changes in rainfall. The Bungle Bungles, however, are situated further south and inland than Gregory (Fig. 3) but have a comparable rainfall (Forbes & Kenneally 1986). The relatively low similarity of this area with Gregory appears to be largely due to the number of rainforest species (eg *Ficus virens* and *Euodia elleryana*) that are found in the deep gullies at the Bungle Bungles that are not found at Gregory. Such refugia appear to be smaller and less common at Victoria River and rare at Bullita. These results concur with the findings of Kirkpatrick *et al* (1988) that sandstone communities are more spatially variable than the more uniformly distributed savanna communities in the northern coastal regions of the Northern Territory.

Table 11

Floristic similarity of various areas in the Northern Territory to Gregory National Park

Location	Uluru N P (Ayers Rock)	Keep River N P	Bungle Bungle Range	Katherine Gorge N P	Litchfield Park (Tabletop Range)	Alligator Region (Kakadu)
Total Species Recorded	320	301	657	165	423	657
Number of Species in common with Gregory	32	160	152	69	144	171
Similarity to Gregory (%)	10	53	37	42	34	33

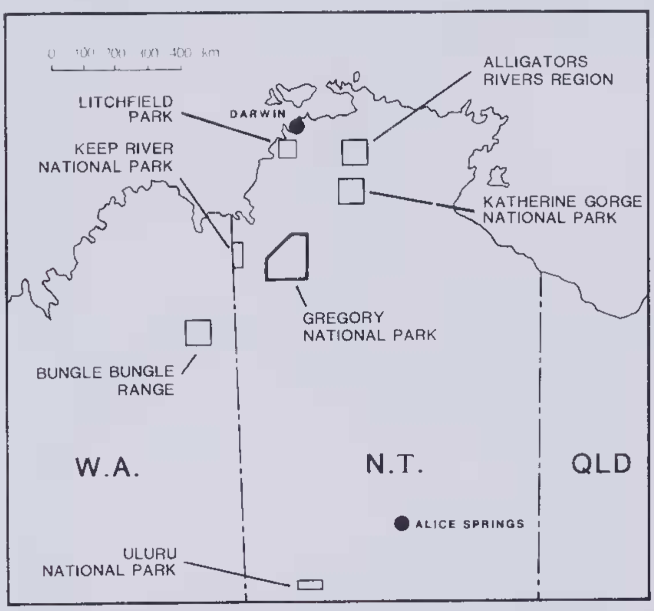

Figure 7 Location of areas from which floristic lists were compared with Gregory National Park.

East-west differences are reflected in a comparison of the number of species held in common with the Alligator Rivers Region between Victoria and Bullita (130 vs 92). The sandstone escarpments and associated canyons are larger and more frequent at Victoria River and carry many species in common with Kakadu (eg. *Eucalyptus miniata*, *Erythrophleum chlorostachys* and *Ficus* spp.) which do not occur in the drier Bullita environment (Appendix). Further east-west gradients are expressed in the common occurence of *Adansonia gregorii* at Keep River and Bullita but not Victoria River. Also the presence of *Livistona* 'Victoria River' at Victoria River and the Bungle Bungles may reflect an association of sandstone geologies or a relict distribution of the species.

Perry (1970), Forbes & Kenneally (1986), and Sivertsen & Van-Cuylenburg (1986) assume that there is a strong relationship between landform, soils and vegetation. This study has supported this assumption. Perry (1970) notes that after climate, species distributions are most strongly controlled by some factor(s) associated with lithology, particular acidic and basic rocks. This study suggests that local microclimate as determined by landform is very important in controlling vegetation distribution with surface soil texture being a secondary interrelated factor.

Implications for park management

No obviously fire damaged vegetation was encountered in the course of this survey. Burnt sandstone plateau vegetation was observed to be floristically richer than adjacent unburnt patches. The major management problems appear to be associated with introduced herbivores. The bare areas at Bullita (Mapping Unit 12), apparent in the 1968 aerial photography, were still clearly visible at the time of the survey. They may have developed in response to high densities of cattle associated with stock yards and animal camps. Feral donkeys will continue to have an impact on soil erosion following the exclusion of cattle from the park. Clearly there is need to assess the impact and control of these animals.

The second major management problem is associated with the spread of exotic plants throughout the park. The 17 exotic plants encountered in this survey were mainly found on the plain and riverine communities which are also the focus of herbivory. It is likely that a reduction of feral animal populations and subsequent control of erosion will help in controlling the spread of exotics.

Given the variability in plant communities found across the northern part of the Northern Territory, particularly with respect to sandstone areas, there is a need to reserve areas across major environmental gradients to ensure adequate reservation of plant species and habitats. The Gregory National Park is an important addition to the Northern Territory National Park estate as it encompasses previously unreserved plains communites and an important area of sandstone vegetation in an arid extreme of the Australian monsoon tropics.

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